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NASA-15818 (December 2003)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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Superseding NASA-15818 (March 2003)

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DIVISION 15 - MECHANICAL

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12/03

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NATIONAL AERONAUTICS **NASA**
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SECTION 15818

MEDIUM/HIGH PRESSURE DUCTWORK
12/03

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NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This section covers medium/high pressure ductwork for air conditioning systems.

Drawings should supplement specifications by showing limits of round and rectangular duct and duct pressure classification; support provisions; type branch take-offs; elbows used for attenuation; location of dampers, linings, air diffusion devices; curbing at duct floor penetrations; framing or flanged duct segments at wall penetrations; vibration isolation of ducting. Refer to Section 15072, "Vibration Isolation for Air Conditioning Equipment."

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PART 1 GENERAL

1.1 REFERENCES

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NOTE: The following references should not be manually edited except to add new references. References not used in the text will automatically be deleted from this section of the project specification.

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The publications listed below form a part of this section to the extent referenced:

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 350	(1986) Specification for Structural Steel Buildings Load and Resistance Factor Design

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE-03	(1997) Handbook, Fundamentals (IP Edition)
ASHRAE-04	(1997) Handbook, Fundamentals (SI Edition)
ASHRAE-06	(1997) Handbook, HVAC Systems and Equipment (IP Edition)
ASHRAE-Hdbk SE-SI	(2000) Handbook, HVAC Systems and Equipment (SI Edition)

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Specification for Filler Metals for Brazing and Braze Welding

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 36/A 36M	(2001) Standard Specification for Carbon Structural Steel
ASTM A 653/A 653M	(2002) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C 1071	(1991) Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)
ASTM D 257	(1993) Standard Test Methods for D-C Resistance or Conductance of Insulating Materials
ASTM E 90	(1990) Standard Test Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2002) Standard for the Installation of Air Conditioning and Ventilating Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA DSIG	(1989; 1st Ed) HVAC Duct Systems Inspection Guide
SMACNA HVAC DCS	(1995; 2nd Ed) HVAC Duct Construction Standards - Metal and Flexible

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS 2480	(1992) Phosphate Treatment Paint Base

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC-01	(1993; 3rd Ed) Good Painting Practice Steel Structures Painting Manual, Volume 1

1.2 DESIGN REQUIREMENTS

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NOTE: If Section 15003, "General Mechanical Provisions," is not included in the project specification, applicable requirements therefrom should be inserted and the first paragraph deleted. If Section 15072, "Vibration Isolation for Air Conditioning Equipment," is not included in the project specification, applicable requirements therefrom should be inserted and the second paragraph deleted. If Section 15055, "Welding Mechanical," is not included in the project specification, applicable requirements therefrom should be inserted and the third paragraph deleted.

****

[Section 15003, "General Mechanical Provisions," apply to work specified in this section.]

[Section 15072, "Vibration Isolation for Air Conditioning Equipment" applies to work in this section.]

[Section 15055, "Welding Mechanical," applies to work specified in this section.]

Equipment and Performance Data shall be submitted for medium/high pressure ductwork systems consisting of use life, system functional flows, safety features, and mechanical automated details. Curves indicating tested and certified equipment response and performance characteristics shall also be submitted.

Design Analysis and Calculations shall be submitted for medium/high pressure ductwork systems indicating the manufacturer's recommended air velocities, maximum static pressure, and temperature calculations.

1.3 SCOPE OF WORK

High velocity systems shall encompass ductwork where:

Minimum air velocity exceeds 2,000 feet per minute (fpm) 10 meter per second or static pressure exceeds 2 inches water gage (wg) 500 pascal.

[Medium static pressure ranges from over 2 inches wg through 3 inches wg 500 pascal through 750 pascal, positive or negative, or over 3 inches wg through 6 inches wg 750 pascal through 1500 pascal positive.]

[High static pressure ranges from over 6 inches wg through 10 inches wg 1500 pascal through 2500 pascal, positive.]

1.4 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01330, "Submittal Procedures," and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.

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The following shall be submitted in accordance with Section 01330, "Submittal Procedures," in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists and Records of Existing Conditionsshall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

SD-02 Shop Drawings

The following shall be submitted in accordance with paragraph entitled, "Drawings," of this section.

Connection Diagrams
Fabrication Drawings
Installation Drawings
As-Built Drawings

SD-03 Product Data

Equipment and Performance Data shall be submitted for medium/high pressure ductwork systems in accordance with paragraph entitled, "Design Requirements," of this section.

Manufacturer's catalog data shall be submitted for the following

items:

Galvanized Steel Ductwork Materials
Brazing Materials
Mill-Rolled Reinforcing and Supporting Materials
Round Sheet Metal Duct Fittings
Round, High-Pressure, Double-Wall Sheet Metal Ducts
Turning Vanes
Dampers
Sound Traps
Flexible Connectors

SD-05 Design Data

Design Analysis and Calculations shall be submitted for medium/high pressure ductwork systems in accordance with paragraph entitled, "Design Requirements," of this section.

SD-06 Test Reports

Test reports shall be submitted for medium/high pressure ductwork systems in accordance with the paragraphs entitled, "Ductwork Leakage Tests" and "Fire Damper Tests," of this section.

Ductwork Leakage Tests
Operational Tests

SD-07 Certificates

Listing of Product Installations for medium/high pressure ductwork systems in accordance with paragraph entitled, "Installation," of this section.

Certificates shall be submitted, showing conformance with the referenced standards contained in this section for:

Galvanized Steel Ductwork Materials
Brazing Materials
Mill-Rolled Reinforcing and Supporting Materials
Round Sheet Metal Duct Fittings
Round, High-Pressure, Double-Wall Sheet Metal Ducts
Turning Vanes
Dampers
Sound Traps
Flexible Connectors

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with paragraph entitled, "Operation and Maintenance," of this section.

1.5 GENERAL REQUIREMENTS

Records of Existing Conditions shall be submitted consisting of the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work shall constitute acceptance of existing conditions.

Material, Equipment, and Fixture Lists shall include the manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

1.6 DRAWINGS

Connection Diagrams shall be submitted for medium/high pressure ductwork systems indicating the relation and connection of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Fabrication Drawings shall be submitted for medium/high pressure ductwork systems consisting of fabrication and assembly details to be performed in the factory.

Installation Drawings shall be submitted for medium/high pressure ductwork systems. Drawings shall show details of equipment room layout and design.

As-Built Drawings shall provide current factual information including deviations from, and amendments to, the drawings and concealed or visible changes in the work, for medium/high pressure ductwork systems.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Galvanized Steel Ductwork Materials

Galvanized steel ductwork sheet metal shall be carbon steel, of lock-forming quality, hot-dip galvanized, with regular spangle-type zinc coating, conforming to ASTM A 924/A 924M and ASTM A 653/A 653M, Designation G90. Duct surfaces to be painted shall be treated by phosphatizing.

Sheet metal gages thickness and reinforcement thickness shall conform to ASHRAE-06 ASHRAE-Hdbk SE-SI, Chapter 16, ASHRAE-03 ASHRAE-04, Chapter 32 and SMACNA HVAC DCS.

2.1.2 Brazing Materials

Brazing materials shall be silicon bronze conforming to AWS A5.8.

2.1.3 Mill-Rolled Reinforcing and Supporting Materials

Mill-rolled structural steel shall conform to ASTM A 36/A 36M and, wherever in contact with sheet metal ducting, shall be galvanized to commercial weight of zinc or coated with materials conforming to ASTM A 123/A 123M [

SSPC-01].

Equivalent strength, proprietary design, rolled-steel structural support systems may be submitted for approval in lieu of mill-rolled structural steel.

2.2 COMPONENTS

2.2.1 Round Sheet Metal Duct Fittings

Fittings shall be shop fabricated.

Fittings shall be manufactured as separate fittings, not as tap collars welded or brazed into duct sections.

Offset configurations shall be submitted for approval.

Miter elbows shall be two-piece type for angles less than 31 degrees, three-piece type for angles 31 through 60 degrees, and five-piece type for angles 61 through 90 degrees. Centerline radius of elbows shall be 1-1/2 times fitting cross section diameter.

Crosses, increasers, reducers, reducing tees, and 90-degree tees shall be conical type.

Cutouts in fitting body shall be equal to branch tap dimension or, where smaller, excess material shall be flared and rolled into smooth radius nozzle configuration.

2.2.2 Round, High-Pressure, Double-Wall Sheet Metal Ducts

Ducts and fittings shall be shop fabricated.

Construction shall comprise an airtight, vapor barrier, outer pressure shell, a 1 inch 25 millimeter insulation layer, and a perforated-metal inner liner that completely covers the insulation throughout the system.

Insulation shall conform to NFPA 90A and ASTM C 1071. Thermal conductivity shall be in accordance with ASTM D 257.

2.2.3 Duct and Fitting Gages

Outer pressure shell shall be as specified in ASHRAE-06 ASHRAE-Hdbk SE-SI, Chapter 16, ASHRAE-03 ASHRAE-04, Chapter 32 and SMACNA HVAC DCS; the inner liner shall be as recommended by the manufacturer but not lighter than 26-gage 0.55 millimeter.

Perforations shall be 3/32 inch 2.5 millimeter diameter, and the open area shall be 13 percent.

2.2.4 Reinforcement

Inner liners of both duct and fittings shall be supported by metal spacers welded in position to maintain spacing and concentricity.

2.2.5 Fittings

Divided flow fittings shall be made as separate fittings, not tap collars into duct sections, with the following construction requirements:

Sound, airtight, continuous welds at intersection of fitting body and tap

Tap liner securely welded to inner liner, with weld spacing not to exceed 3 inches 75 millimeter

Insulation shall be packed around the branch tap area for complete cavity filling.

Branch connection shall be carefully fit to cutout openings in inner liner without spaces for air erosion of insulation and without sharp projections that cause noise and airflow disturbance.

Seams in the pressure shell of fittings shall be continuously brazed. Galvanized areas that have been damaged by welding shall be protected with manufacturer's standard corrosion-resistant coating.

Offset configurations shall be submitted for approval.

Elbows shall be two-piece type for angles through 35 degrees, three-piece type for angles 36 through 71 degrees, and five-piece type for angles 72 through 90 degrees.

****

NOTE: Delete the following paragraph if low-friction loss thru conical fittings is not a design factor.

****

[Crosses, increasers, reducers, reducing tees, and 90-degree tees shall be conical type.]

2.2.6 Turning Vanes

Turning vanes shall be double-wall type, commercially manufactured for high-velocity system service.

2.2.7 Dampers

Low pressure drop, high-velocity manual volume dampers, and high-velocity fire dampers shall be constructed in accordance with ASHRAE-06 ASHRAE-Hdbk SE-SI, Chapter 16, ASHRAE-03 ASHRAE-04, Chapter 32 and SMACNA HVAC DCS.

2.2.8 Sound Traps

[Sound traps shall be provided.]

****

NOTE: Retain for high-velocity, high-pressure systems or delete when not applicable to the project.

Drawings must supplement following specifications with data sufficient for the manufacturer to properly select sound traps. Data must include cubic feet per minutemeter per second; total static pressure; maximum permissible static pressure drop; air movement data (AMD) configuration; system velocities; type motor if in airstream; sound power level measurement point, in feet millimeter, from terminus where applicable; etc.

Indicate sound traps for all fans operating at static pressures in excess of 4-inches water gage 1000 pascal. Traps shall be provided at fan discharge and inlet where required, also in return air systems.

No standards exist for testing prefabricated sound traps. ASTM E 90 is based on static methods. Rewrite where acoustic testing is based on dynamic insertion loss method.

****

Sound traps shall be factory fabricated, and acoustic confirmation of cataloged attenuation shall be made by an independent laboratory in accordance with ASTM E 90. Pressure drop measurements shall be confirmed in accordance with ASHRAE-06 ASHRAE-Hdbk SE-SI, Chapter 18. Noise-reduction data shall include effects of flanking paths and vibration transmission. Testing shall be with standard metal inlet and outlet connections under indicated capacity flow.

****

NOTE: Select the following paragraph when sound attenuation in decibels (dB) RE 0.0002 microbar is given under the following paragraph for each midfrequency for all octave bands.

Attenuation required should provide present and future needs at least 5 dB excess attenuation in the 250 hertz, third octave band, midfrequency, when compared to specified noise criteria curve for the area.

****

[Attenuation shall be in accordance with ASHRAE-03 ASHRAE-04. Certification shall include a graphic system noise spectrum indicating proposed fan sound power level. Attenuation of ducting system proposed for installation based on ASHRAE-03 for bends, branches, and other duct system construction details; sound pressure level without sound trap; attenuation required; and excess attenuation compared to specific noise criteria curve.]

****

NOTE: Select the following paragraph only when no noise criteria are given and when required by project conditions; otherwise determine performance criteria after analysis of fans and downstream duct work.

****

[Sound trap shall reduce fan-rated sound-power level to not less than 65 decibels in the 250-hertz third octave band when measured at trap discharge end.]

Pressure drop at rated flow shall not exceed ratings in accordance with ASHRAE-06 ASHRAE-Hdbk SE-SI, Chapter 16, ASHRAE-03 ASHRAE-04, Chapter 32 and SMACNA HVAC DCS or design criteria.

Trap shall be airtight when operating under an internal pressure of 0.37 pound per square inch 2600 pascal. Air-side surface shall be capable of withstanding air velocities of 10,000 feet per minute 50 meter per second without any particulate matter leaving the trap and being carried downstream.

Sound traps shall be double-metal walled, [round] [rectangular]. Sheet metal shall be mill-galvanized steel with commercial weight of zinc, conforming to ASTM A 653/A 653M. Exterior metal shall act as a vapor barrier, and metal thickness shall be not less than that required for the pressure service, in accordance with ASHRAE-06 ASHRAE-Hdbk SE-SI, Chapter 16, ASHRAE-03 ASHRAE-04, Chapter 32 and SMACNA HVAC DCS, but not less than 22-gage 0.85 millimeter. Absorbing material, on the sound-impinging side, shall be covered with formed perforated mill-galvanized steel of not less than 24-gage 0.70 millimeter. Exterior sheet joints shall be continuously welded or made with lockseams filled, prior to forming, with a chloroprene mastic.

Interior surfaces shall be spot welded not more than 3 inches 75 millimeter on center. Connections to duct transitions shall be flanged with through-bolted 1/8 inch by 1 inch 3 by 25 millimeter continuous rubber gasketing. Supports shall be trapeze type, vibration isolated.

Absorption material shall be fibrous glass. [Surface exposed to airstream shall be chloroprene coated or protected with woven fibrous-glass cloth conforming to ASTM C 1071.] Total compressed thickness shall provide required attenuation and thermal insulation to preclude condensation on exterior surface under operating conditions normal to installed location. Compressed material density shall be approximately 4.5 pounds per cubic foot 72 kilogram per cubic meter. Material shall conform to fire hazard requirements of NFPA 90A.

[Round, high pressure, double-walled, internally insulated duct and fittings may be provided in lieu of sound traps when requirements specified herein are complied with.]

2.2.9 Flexible Connectors for Sheet Metal

Connectors shall be UL listed, 30-ounce per square foot 915 gram per square

meter, waterproof, fire-retardant, airtight, woven fibrous-glass cloth, double coated with chloroprene. Clear width, not including clamping section, shall be 6 to 8 inches 150 to 200 millimeter.

[Leaded vinyl sheet shall be provided as a second layer for sound attenuation. Leaded vinyl shall be not less than 0.055 inch 1.4 millimeter thick, shall weigh not less than 0.87 pound per square foot 4.25 kilogram per square meter, and shall be capable of approximately 10-decibel attenuation in the 10- to 10,000-hertz range.]

PART 3 EXECUTION

3.1 PREPARATION

Sheet metal construction shall be provided in accordance with the recommendations for best practices in ASHRAE-06 ASHRAE-Hdbk SE-SI, Chapter 16, SMACNA HVAC DCS, NFPA 90A, and ASHRAE-03 ASHRAE-04, Chapter 32.

Where construction methods for certain items are not described in the referenced standards or herein, the work shall be performed in accordance with recommendations for best practice defined in ASHRAE-06 ASHRAE-Hdbk SE-SI.

Sheet metal surfaces to be painted and surfaces to which adhesives are to be applied shall be clean and free of oil, grease, and deleterious substances.

Duct strength shall be adequate to prevent failure under service pressure or vacuum created by fast closure of duct devices. Leaktight, automatic relief devices shall be provided.

Supplementary steel shall be designed and fabricated in accordance with AISC 350.

3.2 INSTALLATION

Listing of Product Installations for medium/high pressure ductwork systems shall include identification of at least 5 units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. List shall include purchaser, address of installation, service organization, and date of installation.

Fabrication shall be airtight and shall include reinforcements, bracing, supports, framing, gasketing, sealing, and fastening to provide rigid construction and freedom from vibration, airflow-induced motion and noise, and excessive deflection at specified maximum system air pressure and velocity.

Where ducts pass through firewalls, a flanged duct segment with fire damper and access door shall be provided in that surface during surface construction.

****

NOTE: Retain only the following sub-parts covering

duct types required for the project.

****

3.3 APPLICATION

3.3.1 Rectangular Sheet Metal Ducts

3.3.1.1 Medium-Pressure Gages, Joints, and Reinforcement

Minimum sheet metal gages, joints, and reinforcements between joints shall be in accordance with ASHRAE-06 ASHRAE-Hdbk SE-SI, Chapter 16, ASHRAE-03 ASHRAE-04, Chapter 32 and SMACNA HVAC DCS.

Sheet metal minimum thickness, transverse reinforcement between joints, and joints of ducts shall be in accordance with the following:

LONGEST SIDE INCHES	SHEET METAL GAGE ALL SIDES	COMPANION ANGLE INCHES	REINFORCEMENT ANGLES INCHES, 24 INCHES ON CENTER MAXIMUM (BACK TO BACK)
97 to 108	16	2 by 2 by 1/8, two tie rods along angle	Two 2 by 2 by 1/8, two tie rods along angle
109 to 132	16	2 by 2 by 3/16, two tie rods along angle	Two 2 by 2 by 3/16, two tie rods along angle
133 and longer	14	2 by 2 by 3/16, with tie rods every 48 inches	Two 2 by 2 by 3/16, with tie rods every 48 inches

LONGEST SIDE (mm)	SHEET METAL THICKNESS ALL SIDES	COMPANION ANGLE (mm)	REINFORCEMENT ANGLES INCHES, 600 (mm) ON CENTER MAXIMUM (BACK TO BACK)
2450 to 2750	1.6	50 by 50 by 3, two tie rods along angle	Two 50 by 50 by 3, two tie rods along angle
2451 to 3350	1.6	50 by 50 by 5, two tie rods along angle	Two 50 by 50 by 5, two tie rods along angle
3351 and longer	2.0	50 by 50 by 5, with tie rods	Two 50 by 50 by 5, with tie rods every

LONGEST SIDE (mm)	SHEET METAL THICKNESS ALL SIDES	COMPANION ANGLE (mm)	REINFORCEMENT ANGLES INCHES, 600 (mm) ON CENTER MAXIMUM (BACK TO BACK)
		every 1200 mm	1200 mm

3.3.1.2 Medium- and High-Pressure Branches, Inlets, Outlets

Branches, inlets, and outlets shall be installed to minimize air turbulence and to ensure proper airflow.

Dampers shall be installed so that the amount of air entering duct mains can be adjusted.

Commercially manufactured air extractors shall be provided to allow adjustment of the air quantity and to provide an even flow of air across the device or duct served.

Where a duct branch is to handle over 25 percent of the air handled by the duct main, a complete 90-degree increasing elbow shall be used, with an inside radius of 0.75 times duct branch width. Size of the trailing end of the increasing elbow within the main duct shall be in the same ratio to the main duct size as the ratio of the relative air quantities handled.

Where a duct branch is to handle 25 percent or less of the air handled by the duct main, the branch connection shall have an inside radius of 0.75 times branch duct width, a minimum arc length of 45 degrees, and an outside radius of 1.75 times duct branch width. Arc shall be tangent to duct main.

3.3.1.3 High-Pressure Gages, Joints, and Reinforcement

Sheet metal minimum thickness, joints, and reinforcement between joints shall be in accordance with ASHRAE-06 ASHRAE-Hdbk SE-SI, Chapter 16, ASHRAE-03, ASHRAE-04, Chapter 32 and SMACNA HVAC DCS.

The following types of ASHRAE-06 ASHRAE-Hdbk SE-SI, Chapter 16, ASHRAE-03 ASHRAE-04, Chapter 32 and SMACNA HVAC DCStransverse joints shall be used:

Welded flange joint [with] [without] angle

Companion angle flanged joint

The following types of longitudinal seams shall be used:

Approved lock seams, back brazed, or continuously brazed seams for ducts with largest dimension up to 72 inches 1800 millimeter

Continuously welded or brazed seams for ducts with largest dimension greater than 72 inches 1800 millimeter

Sheet metal minimum thickness, transverse reinforcement between joints, and companion angle joints of ducts with longest side greater than 96 inches 2550 millimeter shall be in accordance with the following:

LONGEST SIDE INCHES	SHEET METAL GAGE ALL SIDES	COMPANION ANGLE INCHES	REINFORCEMENT ANGLES INCHES, 24 INCHES ON CENTER MAXIMUM (BACK TO BACK)
97 to 108	16	2 by 2 by 1/8, two tie rods along angle	*Two 2 by 2 by 1/8, two tie rods along angle
109 to 132	16	2 by 2 by 3/16, two tie rods along angle	*Two 2 by 2 by 3/16, two tie rods along angle
133 and longer	14	2-1/2 by 2-1/2 by 3/16, with tie rods every 24 inches	*Two 2-1/2 by 2-1/2 by 3/16, with tie rods every 24 inches

LONGEST SIDE (mm)	SHEET METAL THICKNESS ALL SIDES	COMPANION ANGLE (mm)	REINFORCEMENT ANGLES INCHES, 600 (mm) ON CENTER MAXIMUM (BACK TO BACK)
2450 to 2750	1.6	50 by 50 by 3, two tie rods along angle	Two 50 by 50 by 3, two tie rods along angle
2451 to 3350	1.6	50 by 50 by 5, two tie rods along angle	Two 50 by 50 by 5, two tie rods along angle
3351 and longer	2.0	65 by 65 by 5, with tie rods every 600 mm	Two 65 by 65 by 5, with tie rods every 600 mm

3.3.2 Round Sheet Metal Ducts

3.3.2.1 Duct Gages, Joints, and Reinforcement

Sheet metal minimum thickness, joints, and reinforcement between joints shall be in accordance with ASHRAE-06 ASHRAE-Hdbk SE-SI, Chapter 16, ASHRAE-03, ASHRAE-04, Chapter 32 and SMACNA HVAC DCS.

Longitudinal duct joint shall be manufactured by machine, with spiral

lockseams to and including 60 inch 1500 millimeter diameters, and to dimensional tolerances compatible with fittings provided.

Ducts shall have supplemental girth angle supports, riveted with [solid rivets 6 inches 150 millimeter on center] [tack welded] [brazed] to duct. Girth angles shall be located as follows:

DIAMETER, INCHES	REINFORCEMENT-MAXIMUM SPACING, INCHES
25 to 36	1-1/4 by 1-1/4, 1/8 thick, 72 inches on center
37 to 50	1-1/4 by 1-1/4, 1/8 thick, 60 inches on center
51 to 60	1-1/2 by 1-1/2, 1/8 thick, 48 inches on center

DIAMETER, MILLIMETER	REINFORCEMENT-MAXIMUM SPACING, MILLIMETER
625 to 915	32 by 32, 3.2 thick, 1825 millimeter on center
916 to 1270	32 by 32, 3.2 thick, 1525 millimeter on center
1271 to 1525	38 by 38, 3.2 thick, 1220 millimeter on center

Draw band girth joints are not acceptable.

Slip joints shall be made up by coating the male fitting with elastomer sealing materials, exercising care to prevent mastic from entering fitting bore, leaving only a thin annular mastic line exposed internally. Sheet metal screws shall be used to make assembly rigid, not less than four screws per joint, maximum spacing 6 inches 150 millimeter. Pop rivets shall not be used. All joints shall be taped and heat sealed.

Bolt heads and nuts shall be hex-shaped, 5/16 inch diameter M8 for ducts up to 50 inch 1270 millimeter diameter, and 3/8 inch diameter M10 for 51 inch 1271 millimeter diameter ducts and larger.

Flanges shall be [continuously welded] [brazed] to duct on outside of duct and intermittently welded with 1 inch 25 millimeter welds every 4 inches 100 millimeter on inside joint face. Excess filler metal shall be removed from inside face. Galvanized areas that have been damaged by welding shall be protected with manufacturer's standard corrosion-resistant coating.

3.3.2.2 Duct Transitions

****

NOTE: Rectangular duct with transitions specified below should be used wherever building construction or equipment are limiting factors.

****

[Where the shape of a duct changes, the angle of the side of the transition piece shall not exceed 15 degrees from the straight run of duct connected thereto.]

Where equipment is installed in ductwork, the angle of the side of the transition piece from the straight run of duct connected thereto shall not exceed 15 degrees on the upstream side of the equipment and 22-1/2 degrees on the downstream side of the equipment.

3.3.3 Round, High Pressure, Sheet Metal Duct Installation

3.3.3.1 Joints

An inner coupling shall be provided to align the inner lining to maintain good airflow conditions equivalent to standard round high-pressure duct joints. Butt joints are not suitable for the inner liner. This alignment shall be accomplished by [extending the liner of the fitting for slip joint into the pipe] [by the use of a double concentric coupling with the two couplings held by spacers for rigidity and wall spacing]. For ducts over 34 inches 860 millimeter inside diameter, a separate coupling for inner alignment, with the pressure shells joined by angle-ring flanged connections, shall be provided.

3.3.3.2 Insulation Ends

At the end of an uninsulated section or run where internally insulated duct connects to uninsulated spiral duct, fitting, fire damper or flexible duct, an insulation end-fitting shall be installed to bring the outer pressure shell down to nominal size.

3.3.4 Transverse Reinforcement Joints

Transverse reinforcements shall be [riveted with solid rivets to duct sides 6 inches 150 millimeter on center] [spot welded 4 inches 100 millimeter on center]. Transverse reinforcement shall be welded at [all corners] [ends] to form continuous frames.

3.3.5 Joint Gaskets

Flanged joints shall be gasketed with chloroprene full-face gaskets 1/8 inch 3.2 millimeter thick, Shore A 40 durometer hardness. Gaskets shall be one piece, [vulcanized] [dovetailed] at joints.

3.3.6 Radius Elbows

Elbow proportions and radius elbows shall be fabricated in accordance with ASHRAE-06 ASHRAE-Hdbk SE-SI, Chapter 16, ASHRAE-03 ASHRAE-04, Chapter 32 and SMACNA HVAC DCS.

3.3.7 Plenum Connections

Round duct connections shall be welded joint bellmouth type.

Rectangular duct connections shall be bellmouth type, constructed in accordance with ASHRAE-06 ASHRAE-Hdbk SE-SI, Chapter 16, ASHRAE-03 ASHRAE-04, Chapter 32 and SMACNA HVAC DCS.

3.3.8 Access Openings

Access panels shall be installed in ductwork adjacent to fire dampers.

Minimum size of access opening shall be 12 by 18 inches 300 by 450 millimeter, unless precluded by duct dimension.

Access openings shall be framed by welded and ground miter joint, 1/8 inch 4 millimeter thick [strap steel] [angle iron], with [1/4] [3/8] inch [7] [10] millimeter studs welded to frame. Cover plate shall be not less than [16-gage 1.6 millimeter, reinforced as necessary for larger sizes] [constructed of 12-gage 2.8 millimeter metal].

In lieu of access doors, readily accessible flanged duct sections may be provided upon approval. Stable hanger supports shall be provided for disconnected duct termini.

3.3.9 Duct Supports

****
NOTE: Areas of seismic activity require seismically braced ducts per SMACNA.
****

Duct support shall be installed in accordance with ASHRAE-06 ASHRAE-Hdbk SE-SI, Chapter 16, ASHRAE-03 ASHRAE-04, Chapter 32 and SMACNA HVAC DCS. Duct hangers shall meet the minimum size specified in ASHRAE-06 ASHRAE-Hdbk SE-SI, Chapter 16, ASHRAE-03 ASHRAE-04, Chapter 32 and SMACNA HVAC DCS. Two hangers shall be provided where necessary to eliminate sway. Support attachment to duct surfaces, shall be by [solid rivet] [bolt] [welding] 4 inches 100 millimeter on center.

****
NOTE: Delete following paragraph if double-wall ducts are not required.
****

[Round, double-wall duct supports shall be as recommended by the manufacturer except that minimum hanger ring and strap size shall be 1-1/2 inches by 1/8 inch 40 by 4 millimeter.]

Selection of hanging system shall be at the Contractor's option, and shall take into account the location and precedence of work under other sections, interferences of various piping and electrical conduit, equipment, building configuration, structural and safety factor requirements, vibration, and imposed loads under normal and abnormal service conditions. Support sizes, configurations, and spacings are given to show the minimal type of supporting components required. If installed loads are excessive for the specified hanger spacing, hangers, and accessories [heavier-duty components

shall be provided] [hanger spacing shall be reduced]. After system startup, any duct support device which, due to length, configuration, or size, vibrates or causes possible failure of a member, shall be replaced or the condition shall otherwise be alleviated. Special care shall be exercised to preclude cascade-type failures.

Hanger rods, angles, and straps shall be attached to beam clamps. Concrete inserts, masonry anchors, and fasteners shall be approved for the application.

****

NOTE: The following devices are an acceptable fastener in office buildings where unusual conditions do not occur.

****

Hardened high-carbon spring-steel fasteners fitted onto beams and miscellaneous structural steel are acceptable upon prior approval of each proposed application and upon field demonstration of conformance to specification requirements. Fasteners shall be made from steel conforming to AISI Type [1055] [1070], treated and finished in conformance with SAE AMS 2480, Type Z (zinc phosphate base), Class 2 (supplementary treatment). A 72-hour load-carrying capacity shall be verified by a certified independent laboratory.

Hanger spacing shall provide a 20-to-1 safety factor for supported load.

Maximum load supported by any two fasteners shall be 100 pounds 45 kilogram.

Friction rod assemblies are not acceptable.

[Where support from metal deck systems is involved, support requirements shall be coordinated with installation of metal deck.]

Ductwork and equipment shall not be hung from roof deck, piping, or other ducts or equipment. Maximum span between any two points shall be 10 feet 3000 millimeter, with lesser spans as required by duct assemblies, interferences, and permitted loads imposed.

There shall be not less than one set of hangers for each point of support. Hangers shall be installed on both sides of all duct turns, branch fittings, and transitions.

Hangers shall be sufficiently cross braced to eliminate sway vertically and laterally.

Rectangular ducts up to 36 inches 900 millimeter shall be supported by strap-type hangers attached at not less than three places to not less than two duct surfaces in different planes.

Perforated strap hangers are not acceptable.

Rectangular ducting, 36 inches 900 millimeter and larger, shall be supported by trapeze hangers. Ducts situated in unconditioned areas and

required to have insulation with a vapor-sealed facing shall be supported on trapeze hangers. Hangers shall be spaced far enough out from the side of the duct to permit the duct insulation to be placed on the duct inside the trapeze. Duct hangers shall not penetrate the vapor-sealed facing.

Where trapeze hangers are used, the bottom of the duct shall be supported on angles sized as follows:

WIDTH OF DUCT, INCHES	MINIMUM BOTTOM ANGLE SIZE, INCHES
30 and smaller	1-1/4 by 1-1/4 by 1/8
31 to 48	1-1/2 by 1-1/2 by 1/8
49 to 72	1-1/2 by 1-1/2 by 3/16
73 to 96	2 by 2 by 1/4
97 and wider	3 by 3 by 1/4

WIDTH OF DUCT, MILLIMETER	MINIMUM BOTTOM ANGLE SIZE, MILLIMETER
760 and smaller	32 by 32 by 3.2
761 to 1200	38 by 38 by 3.2
1201 to 1830	38 by 38 by 4.8
1831 to 2440	50 by 50 by 6.4
2441 and wider	75 by 75 by 6.4

Where ductwork system contains heavy equipment, excluding air-diffusion devices and single-leaf dampers, such equipment shall be hung independently of the ductwork by means of rods or angles of sizes adequate to support the load.

Ducting, when supported from roof purlins, shall not be supported at points greater than one-sixth of the purlin span from the roof truss. Load per hanger shall not exceed 400 pounds 875 kilogram when support is from a single purlin or 800 pounds 1750 kilogram when hanger load is applied halfway between purlins by means of auxiliary support steel provided under this section. When support is not halfway between purlins, the allowable hanger load shall be the product of 400 times the inverse ratio of the longest distance to purlin-to-purlin spacing.

When the hanger load exceeds the above limits, reinforcing of purlin(s) or additional support beam(s) shall be provided. When an additional beam is used, the beam shall bear on the top chord of the roof trusses, and bearing shall be over gusset plates of top chord. Beam shall be stabilized by connection to roof purlin along bottom flange.

Purlins used for supporting fire-protection sprinkler mains, electrical lighting fixtures, electrical power ducts, or cable trays shall be

considered fully loaded, and supplemental reinforcing or auxiliary support steel shall be provided for these purlins.

****

NOTE: When vibration isolation is required, retain applicable portions of the following two paragraphs.

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[Duct supports shall be vibration isolated from structure at points indicated. Refer to Section 15072, "Vibration Isolation for Air Conditioning Equipment."]

[Vibration isolators shall be provided in discharge ducting system for a distance not less than 50 feet 15 meter beyond the air handling unit. Deflection of duct and equipment mountings shall be coordinated.]

3.3.10 Flexible Connectors for Steel Metal

Air-handling equipment, ducts crossing building expansion joints, and fan inlets and outlets shall be connected to upstream and downstream components by treated woven-cloth connectors.

Connectors shall be installed only after system fans are operative and all vibration isolation mountings have been adjusted. When system fans are operating, connectors shall be free of wrinkles caused by misalignment or fan reaction. Width of surface shall be curvilinear.

3.3.11 Insulation Protection Angles

Galvanized 20-gage 1 millimeter thick sheet, formed into an angle with a 2 inch 50 millimeter exposed long leg with a 3/8 inch 10 millimeter stiffening break at outer edge, and with a variable concealed leg, depending upon insulation thickness, shall be provided.

Angles shall be installed over all insulation edges terminating by butting against a wall, floor foundation, frame, and similar construction. Angles shall be fastened in place with blind rivets through the protection angle, insulation, and sheet metal duct or plenum. Angles shall be installed after final insulation covering has been applied.

3.3.12 Duct Probe Access

Holes shall be provided with neat patches, threaded plugs, or threaded or twist-on caps for air-balancing pitot tube access. Extended-neck fittings shall be provided where probe access area is insulated.

3.3.13 Openings in Roofs and Walls

Building openings are fixed and equipment shall be provided to suit.

3.4 FIELD QUALITY CONTROL

3.4.1 Fire Damper Tests

[Operational tests shall be performed on each fire damper in the presence of the Contracting Officer by enervating fusible link with localized heat. New links shall be provided and installed after successful testing.]

3.4.2 Ductwork Leakage Tests

Contractor shall conduct complete leakage test of new ductwork in accordance with Section 15950, "Testing, Adjusting and Balancing." Tests shall be performed prior to installing ductwork insulation.

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NOTE: Delete the following paragraph and title if inspections are not required.

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3.4.3 Inspection

[Ductwork shall be inspected in accordance with SMACNA DSIG.]

3.5 DUCTWORK CLEANING PROVISIONS

Open ducting shall be protected from construction dust and debris in a manner approved by the Contracting Officer. Dirty assembled ducting shall be cleaned by subjecting all main and branch interior surfaces to airstreams moving at velocities two times specified working velocities, at static pressures within maximum ratings. This may be accomplished by: filter-equipped portable blowers which remain the Contractor's property; wheel-mounted, compressed-air operated perimeter lances which direct the compressed air and which are pulled in the direction of normal airflow; and other means approved by the Contracting Officer. Compressed air used for cleaning ducting shall be water- and oil- free. After construction is complete, and prior to acceptance of the work, construction dust and debris shall be removed from exterior surfaces. [SMACNA DSIG.]

3.6 OPERATION AND MAINTENANCE

Contractor shall submit [6] [_____] copies of the Operation and Maintenance Manuals 30 calendar days prior to testing the medium/high pressure ductwork systems. Data shall be updated and resubmitted for final approval no later than 30 calendar days prior to contract completion.

-- End of Section --